What is claimed is:

1. A micro-actuator comprising

a base plate on which a predetermined pattern of signal lines is formed;

a plurality of fixed comb-type electrodes that are arranged on the base plate and extend in a direction perpendicular to the base plate;

a stage capable of a see-saw motion that is arranged at a predetermined height from the top of the base plate;

a plurality of driving comb-type electrodes which are formed parallel to each other on the bottom of the stage and whose ends extend between the fixed comb-type electrodes;

a torsion bar with a predetermined length that is arranged at both ends of the stage forming one body with the stage in order to enable the see-saw motion of the stage;

a first frame layer connected to both ends of the torsion bar;

a second frame layer that is positioned below the first frame layer, thus forming a layered structure with the first frame layer; and

a metal eutectic bonding layer formed between the first and second frame layers to bond them together.

2. The micro-actuator of claim 1, wherein the first frame layer, the torsion bar, the stage, and the driving comb-type electrodes form one body.

3. The micro-actuator of claim 1, wherein

the first frame layer has a shape of a rectangular border that surrounds the stage;

a separate region of a predetermined width is prepared between the first frame layer and the stage; and

the torsion bar crosses the separate region.

4. The micro-actuator of claim 1, wherein

the first frame layer has a shape of a rectangular border that surrounds the stage;

a separate region of a predetermined width having a shape of rectangular border is prepared between the first frame layer and the stage; and

the torsion bar crosses the separate region.

Sub A1

5. The micro-actuator of any of claims 1 - 4, wherein

the fixed comb-type electrodes are formed on an electrode base that is arranged on the base plate, and

the electrode base, the fixed comb-type electrodes and the second frame layer are formed of the same material plate.

6. The micro-actuator of claim 5, wherein the height of the fixed comb-type electrodes is greater than that of the second frame layer, and thus the front ends of the fixed comb-type electrodes are positioned higher than the top of the second frame layer.

Sub A2

7. The micro-actuator of any of claims 1 - 4, wherein the height of the fixed comb-type electrodes is greater than that of the second frame layer, and thus the front ends of the fixed comb-type electrodes are positioned higher than the top of the second frame layer.

8. The micro-actuator of any of claims 1 - 4, and 6, wherein

the front ends of the driving comb-type electrodes and the first frame layer are on a common plane.

9. The micro-actuator of claim 5, wherein the front ends of the driving comb-type electrodes and the first frame layer are on a common plane.

Sub A3

10. The micro-actuator of any of claims 1 - 4, 6, and 9, wherein the metal eutectic bonding layer of the present invention is composed of a plurality of metal layers, among which the middle metal layer is plated with Au/Sn alloy.

11. A method for manufacturing a micro-actuator comprising the steps of:

forming a top structure by etching both sides of a first plate, the top structure comprising a stage, a plurality of comb-type electrodes formed on the bottom of the stage, a torsion bar positioned in the middle of both edges facing the stage, and a first frame layer of a predetermined height supporting the torsion bar;

forming a bottom structure by etching both sides of a second plate, the bottom structure comprising a base plate, a second frame layer formed on the base plate and having a predetermined height corresponding to the first frame layer height, and a plurality of fixed comb-type electrodes formed on the base plate; and

joining the top and bottom structure to form one body by forming a eutectic bonding layer between the first frame layer and the second frame layer, and superimposing the driving and fixed comb-type electrodes such that the extensions of the driving comb-type electrodes alternate with the extensions of the fixed comb-type electrodes

12. The method for manufacturing a micro-actuator of claim 11, wherein the step of forming the top structure further comprises the steps of:

forming a top separate region with a predetermined width and depth corresponding to the space between the stage and the first frame layer;

forming a top metal layer on a region corresponding to the first frame layer; and

forming the driving comb-type electrodes with a predetermined height on the bottom of the stage, while the separate region is penetrated by etching the bottom of the first plate with a predetermined pattern.

13. The method for manufacturing a micro-actuator of claim 11, wherein the step of forming the bottom structure further comprise the steps of:

forming signal lines with a predetermined pattern corresponding to the constituent elements;

forming a bottom separate region with a predetermined width and depth corresponding to the space between the second frame layer and the fixed comb-type electrodes;

joining the bottom of the second plate to the top of the base plate;

etching the region corresponding to the second frame layer to a predetermined depth on the top of the second plate;

forming a bottom metal layer on the etched part of the second plate;

forming a mask layer on the region corresponding to the second frame layer and the fixed comb-type electrodes on top of the second plate; and

forming the fixed comb-type electrodes with a predetermined height inside of the bottom separate region, while the bottom separate region is penetrated by etching to a predetermined depth the region that is not covered by the mask layer.

14. The method for manufacturing the micro-actuator of claim 12, wherein the step of forming the bottom structure further comprise the steps of:

forming signal lines with a predetermined pattern corresponding to the constituent elements;

forming a bottom separate region with a predetermined width and depth corresponding to the space between the second frame layer and the fixed comb-type electrodes;

joining the bottom of the second plate to the top of the base plate;

etching the region corresponding to the second frame layer to a predetermined depth on the top of the second plate;

forming a bottom metal layer on the etched part of the second plate;

forming a mask layer on the region corresponding to the second frame layer and the fixed comb-type electrode on top of the second plate; and

forming the fixed comb-type electrode with a predetermined height inside of the bottom separate region, while the bottom separate region is penetrated by etching to a predetermined depth the region that is not covered by the mask layer.

Sub A4

15. The method for manufacturing a micro-actuator of claims 12 or 14, wherein the step of forming the top metal layer further comprises the steps of

forming a metal seed layer on the bottom of the first plate; and

forming a metal eutectic bonding layer by a plating method on the seed layer.

16. The method for manufacturing a micro-actuator of claim 15, wherein the step of joining the top and bottom structures into one body further comprises a step of performing the metal eutectic bonding at a predetermined temperature and pressure in order to join the first frame layer of the top structure to the second frame layer of the bottom structure, and more specifically to join the top metal layer of the first frame layer of the top structure to the bottom metal layer of the second frame layer of the bottom structure.

Sub A5

17. The method for manufacturing a micro-actuator of claims 13 or 14, wherein the step of forming a bottom metal layer on the second frame layer of the bottom structure further comprises a step of performing the metal eutectic bonding at a predetermined temperature and pressure in order to join the first frame layer of the top structure to the second frame layer of the bottom structure, and more specifically to join the top metal layer of the first frame layer of the top structure to the bottom metal layer of the second frame layer of the bottom structure.

Sub A5 Cont.

18. The method for manufacturing a micro-actuator of any of claims 11-16, wherein the bottom of the second plate is joined to the top of the base plate by an anodic bonding process.

19. The method for manufacturing the micro-actuator of any of claims 17, wherein the bottom of the second plate is joined to the top of the base plate by an anodic bonding process.